Media Peternakan, December 2011, pp. 175-178
EISSN 2087-4634
Accredited by DGHE No: 66b/DIKTI/Kep/2011

Online version:
http://medpet.journal.ipb.ac.id/
DOI: 10.5398/medpet.2011.34.3.175

The Comparison of Doxycycline Residue in the Meat of Broiler Chickens Administered in Feed and Water

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(Received 29-10-2010; accepted 21-09-2011)

ABSTRAK

Penelitian ini bertujuan untuk menguji efek doksisiklin (golongan tetrasiklin) yang diberikan dalam dosis pencegahan setiap hari melalui pakan dan air minum terhadap residu yang timbul pada daging broiler. Sebanyak 100 ppm doksisiklin dicampur dalam air minum (1 g/10 l air minum) dan pakan (1 g/10 kg pakan) diberikan setiap hari selama pemeliharaan. Sampel daging ayam diambil setiap minggu untuk pemeriksaan residu menggunakan kromatografi cair kinerja tinggi dengan proses ekstraksi jaringan sesuai standar *Association of Official Analytical Chemistry*. Hasil pemeriksaan residu menunjukkan bahwa pada kelompok ayam yang diberi doksisiklin melalui air minum memiliki kadar residu lebih tinggi (P<0,05) dibandingkan kelompok ayam yang diberi doksisiklin lewat pakan, kecuali pada minggu kelima, tidak menunjukkan perbedaan yang nyata. Kadar residu tertinggi ditemukan pada minggu pertama kelompok air minum (0,96±0,15 μg/g), dan kadar terendah pada minggu keenam pada kelompok pakan (0,10±0,01 μg/g). Kadar residu doksisiklin yang melebihi batas yang diijinkan oleh Standar Nasional Indonesia sebesar 0,1 μg/g. Dapat disimpulkan bahwa pemberian doksisiklin dalam dosis pencegahan setiap hari tidak dianjurkan karena mengakibatkan residu yang tinggi dalam daging broiler.

Kata kunci: doksisiklin, residu, ayam broiler

ABSTRACT

The purpose of this research was to investigate the effect of doxycycline (a tetracycline derivative) administered at disease-prevention dose given daily in the feed and drinking water on the residue level in the broiler-chicken meat. Doxycycline at concentration of 100 ppm was mixed in the drinking water (1 g of doxycycline in 10 L of drinking water) and feed (1 g of doxycycline in 10 kg of feed). Samples of chicken meat were taken every week to measure their residue level. Analysis of doxycycline level was performed using high performance liquid chromatography with extraction method referring to the standard of Association of Official Analytical Chemistry. The result showed that the residue level in the group of chickens given doxycycline through drinking water was higher (P<0.05) than in the group given doxycycline through the feed, except for the result in the 5th week, that showed no significant difference. The highest residue level was found at the first week in the group given doxycycline in drinking water (0.96±0.15 μg/g), while the lowest was found at the sixth week in the group given doxycycline in the feed (0.10±0.01 μg/g). The level of doxycycline residue exceeding the level permitted by the Indonesian National Standard (0.1 μg/g). It can be concluded that doxycycline is not recommended to be given daily both through water or feed to commercial chickens as a disease-prevention agent.

Key words: doxycycline, residue, broiler chicken

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INTRODUCTION

Commercial chickens diet always use feed additive, which includes antibiotics as one of its main ingredients. Some of farmer used to apply antibiotics for the disease prevention with unwise of application or recommended dosage. These antibiotics are expected to help increase the body-weight by inducing the production of vitamin B-complex in the chicken's digestive system (Chopra & Robert, 2001). The negative effect utilization of antibiotics for chicken will be deposit residue into eggs and meat. The residue of antibiotics in chicken meat consumed by people will cause residue in the human body and create resistance due to the continuous under-therapeutic-dose which was received, as well as misbalance of normal microbial in the gut that can reduce or eliminate the non pathogen bacteria (Rodvold, 2001). The high concentration of antibiotics can also create negative effects to consumers, such as allergic reactions, transfer of residue, lower meat quality, risk of carcinogenic effects, etc.

Research of residue on edible tissues in United States conducted by Donoghue (2003) revealed that many antibiotics including tetracyclines had found on many products. Some antimicrobials, such as tetracyclines, fluoroquinolon, chloramphenicol, sulphonamid, and pesticides, such as organochlorine and organophoaphat, were found in chicken meat. The institute corporation deal to challenge the residues problem by conducting new techniques as confirmation, such as pharmacokinetic study to measure the residue. Alhendi *et al.* (2000) conducted a research on oxytetracycline being used as curative and preventative medicine given in the feed to broiler chicken for 40 days, and found that the residue of oxytetracycline reached the level of 0.24-2.25 μg/g in the plasma, liver, kidney, and muscle. In the USA, 2.5 million of microbial is used every year to improve farm productivity, with 80% of it is used in poultry (Schneider & Lehotay, 2004).

This research was conducted to reveal the residual effect caused by the using of doxycycline as disease-prevention-agent given through feed and drinking water during broiler rearing period and would have the product safe from farm to consume.

MATERIALS AND METHODS

Forty eight (48) day old chicks (DOC) were divided into two groups (24 each of group). The first group was given doxycycline through the drinking water 1 g/100 (preventive dose of 100 ppm). The second group was given doxycycline into feed 1 g of doxycyline/10 kg (preventive dose of 100 ppm). All the groups were fed with diet contents of 22% crude protein and 3000 kcal of metabolizable energy (Table 1). Feed and drinking water was given *ad libitum* daily for 6 weeks. The chickens were also given vaccinations against Newcastle disease and Gumboro. Samples were taken each week (4 chickens were euthanized in each group), starting from week 1 to 6. Meat samples were taken from breast region as the part that commonly consumed and stored in the freezer before being analyzed.

Analysis of Residue Level

Analysis of doxycycline level was performed by referring to the standardized method of tetracycline residue analysis authorized by AOAC (Association of Official Analytical Chemistry) (AOAC, 2005). Five gram of sample was homogenized with 20 ml of Mc Ilvine buffer- EDTA, shaken at high speed, and centrifuged at 2,500 g for 10 minutes. The next step was rinsed with 2 ml of Mc Ilvine buffer-EDTA and centrifugation with the same speed. After three (3) repetition of centrifugation, the supernatant was collected and centrifuged at 2,500 g for 20 min. A 20 μl of supernatant was then injected to HPLC system.

Data Analysis

Data of doxycycline level in the meat (muscle tissue) from group 1 and 2 was analyzed with student T-test to evaluate the comparison of the level from week 1 to 6.

Table 1. Composition and nutrient content of diets

Ingredients	Amount (%)	Protein (%)	Metabolizable energy (kcal/kg)	Calcium (%)	Phosphorous (%)
Meat bone meal	10.0	4.824	219.50	0.888	0.452
Soybean meal	10.0	4.518	223.00	0.036	0.067
Poultry bone meal	5.0	3.050	147.50	0.279	0.133
Corn glutein meal	5.0	3.163	186.00	-	0.014
Yellow corn	43.0	3.655	1440.50	0.008	0.034
Rice bran	25.0	3.050	745.00	0.012	0.035
Palm oil	0.5	-	43.00	-	-
Filler (Sand)	0.5	-	-	-	-
Doxycycline	1.0	-	-	-	-
Total	100.0	22.260	3004.50	1.223	0.735

RESULTS AND DISCUSSION

Measurement of residue in group 1 showed high accumulation in the first week (0.96±0.15), followed then by decline of residue level, and became constant starting from week 2 until week 6. In the second group, residue level kept increasing started from week 1 to reach maximum level in week 3 (0.15±0.04), and then declined to reach the lowest level in week 6 (0.1±0.015) (Table 2). The residue level of group 1 was higher at week 1 than constant at the next weeks. The level of doxycycline was quite constant in group 2. This proved that daily administration of the medicine is able to maintain the level of medicine that has been gained. Table 3 showed the feed and water consumption during weeks 1 until 6 for both treatments.

Based on that result, it could be compared that in the group given doxycycline through the drinking water showed higher level of residue compared to the feed (P<0.05), with the exception for the comparison in week 5. Shargel *et al*. (2005) stated that the distribution volume of medicine would increase when the medicine was diluted in a solution, thus increase absorption rate. In the experiment showed that doxycycline had better distribution-volume when mixed into drinking water, so the residue of the medicine in the muscle was higher in group 1, as reported by Alhendi *et al.* (2000) and Basha *et al.* (2006) that examined the residue of oxytetracycline (another derivative of tetracycline) that was given as medication or disease-prevention given for 40 days. Residue of oxytetracycline in the broiler muscle in this research reached 0.24-2.25 μg/g.

According to Ismail & Kattan (2004), doxycycline administered at dose of 20 mg/kg bodyweight could still be detected in the broiler muscle after 5 days of administration. Laczay *et al*. (2001) reported that doxycycline level in the tissues of liver, kidney, muscle, and lungs reached a range of 0.028-0.20 μg/g was able to be measured until the fifth day after single-dose of intravenous administration. This research in line with Wijayanti *et al.* (2009) who revealed that the elimination half life (T1/2) of doxycycline in the muscle was 55.5 hours and the period of elimination time was long. Alsarra *et al.* (2005) found that the T1/2 of doxycycline in plasma was 16-17 hours given by oral formulation. The long elimination time and continuous administration will cause the persistence of drug level in high concentration for a long period.

Medication using doxycycline has been widely used in animals and gained favour due to the better tissue penetration and higher absorption, thus reduce frequency of administration (Nicolau, 2003). Prats *et al.* (2005) also wrote that doxycycline has better efficacy than older tetracycline group because of its good penetration and lower bound to calcium. This drug has proven the efficacy base from its pharmacokinetic profile to concur the poultry diseases caused by infections of *Micoplasma gallisepticum, Staphylococcus aureus, Streptococcus pneumoniae, Pasteurella multocida, Bordetella bronchiseptica,* and *Escherichia coli* (Wijayanti *et al.*, 2009).

At European countries farms, doxycycline has been used as curative and preventative medicine, and based on the research conducted by Craigmill (2003), the presence of residue in the muscle was quite high. Administration of higher level doxycycline into drinking water made it effective for medication, but this gave higher residue level.

Minimum level of doxycycline residue in the meat according to Indonesia National Standard (SNI-01-6366-2000) is 0.1 mg/kg or 0.1 μg/g, so administration of doxycycline at preventative dose given daily during rearing period is not recommended, even though from

Table 2. Weekly residual level of doxycycline in the broiler meat during rearing period (μg/g)

Time	Residue level	
	Group 1	Group 2
Week 1	0.96±0.15[a]	0.13±0.04[b]
Week 2	0.27±0.02[a]	0.12±0.03[b]
Week 3	0.33±0.12[a]	0.15±0.02[b]
Week 4	0.22±0.05[a]	0.13±0.03[b]
Week 5	0.22±0.05	0.12±0.10
Week 6	0.29±0.15[a]	0.10±0.01[b]

Note: Means in the same row with different superscript differ significantly (P<0.05). Group 1= doxycycline in drinking water; Group 2= doxycycline in feed. SNI maximum residue limit is 0.1.

Table 3. The weekly consumption of feed and water during rearing period

	Week					
	1	2	3	4	5	6
Feed consumption (g)						
Group 1	752.9±21.6	1,600.0± 0.0[a]	2,515.0±205.5	2,335.0±345.7	1,355.0±270.8	1,570.0±206.8
Group 2	745.9±40.9	1,595.0± 6.0[b]	2,572.5±147.3	2,497.5±398.0	1,530.0± 82.5	1,505.0±446.4
Water consumption (ml)						
Group 1	235.4±73.8	373.5±70.0[a]	525.3± 64.6	605.2± 50.8	375.1±106	454.5± 59.0
Group 2	341.6±26.8	558.9±34.0[b]	580.1± 57.5	527.5±100.2	382.0±122	551.9±126.6

Note: Means in the same column with different superscript differ significantly (P<0,05)

the point of medication, level above 0.1 μg/g was proved effective.

CONCLUSION

The administration of doxycycline that of drinking water gave the higher level of residue than that of feed administration. Doxycycline administration at preventive dose is not recommended to be given daily to broiler chickens.

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